

Original article

Effect of *Tamarindus indica* on Blood Pressure of Stage II Hypertensive Patients in a Tertiary Level Hospital

Fatema-Tui-Johura¹, Md. Ismail Khan², Eliza Omar Eva³, Masuma Khanam⁴, Mohammad Kamrul Hasan⁵, Saugata Mitra⁶

ABSTRACT

BACKGROUND: Hypertension is recognized as one of the major contributors to the disease burden globally. Use of polypharmacy is a common phenomenon to treat moderate to severe hypertension. The burden of drug can be lessened by concomitant use of natural herbs that are easily available around us. *Tamarindus indica* which is locally known as tamarind, has a wide range of medicinal application and positive effect on cardiovascular health. **OBJECTIVE:** To see the effect of *Tamarindus indica* on blood pressure of stage II hypertensive patients. **METHODS:** Patients with primary hypertension stage II attended in the outpatient department of medicine of Dhaka Medical College Hospital, were enrolled in the study. Among 90 participants, random allocation was done in test and control group where 45 participants were in test group and 45 participants were in control group. The pulverized pulp of *Tamarindus indica* fruit at a dose of 15 mg/kg/day had been given to the test group for 8 weeks along with drugs. The control group was only on drugs. Blood pressure was recorded at weekly interval in both test and control group. The results obtained from test group had been compared with that of control group. **RESULTS:** In case of control group systolic blood pressure was 123.88 ± 3.45 mm of Hg and diastolic blood pressure was 78.55 ± 3.16 mm of Hg. After taking tamarind for 8 weeks, mean the systolic and diastolic blood pressure of intervention group became 122.66 ± 5.26 and 73.66 ± 3.26 mm of Hg respectively. Though the fruits exerted no conspicuous effect on systolic blood pressure ($p=0.19$), it significantly reduced the diastolic pressure ($p=0.001$) as confirmed by independent sample *t*-test at 5% significance level. **CONCLUSION:** *Tamarindus indica* reduced diastolic blood pressure in stage II hypertensive patients. In Bangladesh where hypertension shows a rising trend, the finding of the study definitely reveals a new dimension on the effect of fruits of *Tamarindus indica* on hypertension.

Key words: *Tamarindus indica*, Hypertension (HTN), Blood Pressure (BP)

INTRODUCTION

Hypertension has become a significant health problem globally. Studies show that the prevalence of hypertension has increased by 30 times among the urban population over period

of 55 years and about 10 times among the rural population over a period of 36 years.¹ Treating hypertension in proper way needs awareness and exploration of new drugs and methods along with traditional drugs. Bangladesh has a rich source of trees and natural herbs with medicinal value and can be effectively used in controlling hypertension. Use of plants and herbs in treating disease dates back to ancient times² and still now they are being used throughout the whole world for cure of various diseases by practitioners of folk medicine. Use of plants for purpose of treatment is popular in underdeveloped countries because of easy availability and cheapness. More recently safety and therapeutic use of medicinal plants and herbs have led to their increasing popularity in developed countries.³ According

Author Affiliations

1. *Dr. Fatema-Tui-Johura, Medical Officer, Department of Pharmacology, Rangpur Medical College, Rangpur. fatemajessy@gmail.com Mobile: +8801717514875
2. Professor Md. Ismail Khan, Vice Chancellor, Chittagong Medical University, Chittagong
3. Prof. Eliza Omar Eva, Department of Pharmacology, Shaheed Suhrawardy Medical College, Dhaka
4. Dr. Masuma Khanam, Assistant Professor, Department of Pharmacology, Mugda Medical College, Dhaka
5. Dr. Mohammad Kamrul Hasan, Assistant Professor, Department of Pharmacology, Shaheed Tajuddin Ahmed Medical College, Gazipur.
6. Dr. Saugata Mitra, Lecturer, Department of Pharmacology, Pabna Medical College, Pabna.

*For correspondence

to World Health Organization (WHO), over 80% of the world population relies upon traditional plants based system of medicine to provide them with primary healthcare.⁴ Bangladesh possesses a rich kingdom of medicinal plants. Out of the estimated 5000 species of phanerogams and pteridophytes growing in this country more than a thousand are regarded as having medicinal properties.⁵ Many of the food, vegetable, beverage, spine and ornamental plants, which grow in this country contain medicinally useful chemical constituents like phenol, coumarines, carotinoids, glucosides, flavinoids, alkaloids, xanthines etc⁶ and constitute important items of drugs or therapeutic agents of various medicinal preparations, particularly of unani and ayurvedic preparations.⁷ In the last three decades, a lot of concerned efforts have been channeled into researching into local plants with blood pressure lowering effect, *Tamarindus indica* is a herb of this kind. *T. indicais* evergreen tree that can reach 24m height and 7m girth that has pale yellow and pink flowers.⁸ Thailand, Bangladesh, Indonesia in Asia; Mexico, Costa Rica in America are some of the countries in which this plant is mostly encountered.⁹ Every part of *T. indica* plant (root, body, fruit, leaves) not only has rich nutritional value and broad usage area in medicine but also has industrial and economic importance. According to World Health Organization report, tamarind fruit is an ideal source of all essential amino acids except tryptophan (82%).¹⁰ Its seeds also have similar properties so it becomes an important, accessible protein source especially in countries where protein malnutrition is a common problem. According to phytochemical analysis results, *T. indica* contains phenolic compounds like catenin, procyanidin B₂, epicatechin, tartaric acid, mucilage, pectin, arabinose, xylose, galactose, glucose, uronic acid and triterpen.¹¹ Tamarind has wonderful anti-inflammatory, anti-cholesterol, anti-bacterial properties and

were traditionally recognized long before scientific studies and research were conducted on tamarinds. Tamarind is a good source of anti-oxidants, fiber and potassium that are all significant in promoting a healthy heart. One of the major underlying causes of high blood pressure today is high intake of sodium in our diet. As much as sodium is essential in our bodies, high amounts can seriously harm body organs and result in increase in blood pressure. Adding foods rich in potassium to our diets can reverse the negative effects of sodium in our blood and normalize blood pressure. Tamarind is a rich source of potassium. A half cup of the soft brown pulp contains about 377 mg of potassium. The high potassium content of tamarind helps to reverse the negative effect of sodium in blood and normalize blood pressure. Antioxidant properties of *T. indica* has been shown in many studies.^{8,11,12} Phenol rich food & beverages like red wine, grape seed, green tea & tamarind have hypolipidemic, antiatherosclerotic, antioxidant, anti-inflammatory & immunomodulatory effect. *T. indica* fruit is rich in organic acid, pectin, vitamin, mineral content, polyphenol and flavonoid content. *T. indica* fruit is rich in polyphenol and flavonoid. It shows moderate antioxidant effect. Epidemiological studies have shown that flavonoid intake from fruits & vegetables have beneficial effect on cardiovascular health. *T. indica* seed shows antioxidant effect via its flavonoid, tannin, polyphenol, anthocyanin & oligomeric proanthocyanidin content.

Polysaccharides isolated from *T. indica* seed show the immunomodulatory effect via increasing phagocytosis, inhibiting leukocyte migration and decreases cell proliferation. Triglyceride decreasing effect is associated with epicatech in content of the extract. This compound increases total fatty acid, neutral and acidic sterols excreted via feces and shows its hypolipidemic effect in this way. Tamarind seed and fruit are suggested as a nutritional support in patients with high blood cholesterol levels. Moreover the high potassium and low

sodium content of tamarind helps to lower blood pressure and ensure cardiovascular health.¹³ Developing countries are increasingly faced with the double burden of hypertension and other cardiovascular diseases. In our country where polypharmacy is a common phenomenon to treat moderate to severe hypertension, use of natural herbs like *Tamarindus indica* may play important role in controlling blood pressure more effectively. The aim of the study is to observe the effect of tamarind on stage II hypertensive patients.

MATERIALS & METHODS:

This prospective study was carried out in the Department of Pharmacology in collaboration with outpatient department of Medicine, Dhaka Medical College Hospital, Dhaka between July 2015 and June 2016. A total of 90 patients with primary hypertension stage II attended in the outpatient department of medicine were enrolled in the study. Informed written consent was obtained from the patients after full explanation of the process. Clinical evaluation was done by detailed history regarding presenting illness, dietary pattern and personal habits. Patients of either sex, age ranges from 25 to 60 years with primary hypertension stage II includes in this study. Patients with primary hypertension with comorbidities like cerebrovascular disease, diabetes mellitus, chronic renal disease bronchial asthma and bleeding disorder as well as secondary hypertension excluded from study. According to Joint National Committee (JNC7) stage II HTN define as Systolic BP >160 mm of Hg and Diastolic BP >100 mm of Hg.¹⁴ Among 90 participants random allocation of was done in intervention and control group where 45 participants were in intervention group and the rest 45 participants were in control group. The pulverized pulp of *Tamarindus indica* fruit at a dose of 15 mg/kg/daily had been given to the intervention group for 8 weeks along with drugs. The

control group was only on drugs. Blood pressure was recorded at weekly interval in both intervention and control group. The results obtained from intervention group had been compared with that of control group. Data were compiled and statistical analysis was done with 't' test. Statistical comparison of two independent percentages was done and p value of 0.05 considered statistically significant.

RESULTS:

This study was carried out to determine the effect of *Tamarindus indica* on stage II hypertensive patients. A total of 90 patients, age ranged from 25 to 60 years with a mean of 52 ± 8 years. Mean age of intervention group was 51 ± 7.87 years and control group was 50 ± 5.25 years ($p=0.8317$). The majority of the participants (75.55%) were from the age group of 51-60 years. The percentage of male participants was 52.22% on the other hand female participants were 47.77%. Male participants were more than female in both case. The Education level of 90 participants 31.5 % were higher secondary while 44.1 % graduated, 4.5% secondary & 0.9% illiterate. The prevalence of risk factor of hypertension shows that out of 90 participants 27.7% was suffering from obesity while 20% was sedentary worker. Number of smoker was 33.33% and 7.7% participants had positive family history of hypertension. The prevalence of alcohol and salt intake was 5.5% and 35.55% respectively. Regarding presenting symptoms, 23.33% patients' complaints of dizziness. Other important symptoms were headache 18.88%, tiredness 13.33% but the important thing was, 41.11% participants were symptomless. In case of control group the mean systolic blood pressure was 123.88 ± 3.45 mm of Hg and mean diastolic blood pressure was 78.55 ± 3.16 mm of Hg. On the other hand the mean systolic and diastolic blood pressure of intervention group were 122.66 ± 5.26 and

73.66±3.26 mm of Hg respectively. No significant change was observed in systolic blood pressure after administration of tamarind (p=0.19). However, for diastolic blood pressure, P value for independent sample t-test was found to be p=0.001 which indicates a significant effect of tamarind to lower diastolic blood pressure.

Table I: Effect of tamarind on blood pressure (BP)

	Control group (n=45)	Interventional group (n=45)	P value
Age (yrs.)	50±5.25	51±7.87	0.831
Male	51.11%	53.33%	0.833
Female	48.89%	46.67%	0.833
Systolic BP	122.66±5.26	123.88±3.45	0.196
Diastolic BP	73.66±3.26	78.55±3.16	0.001

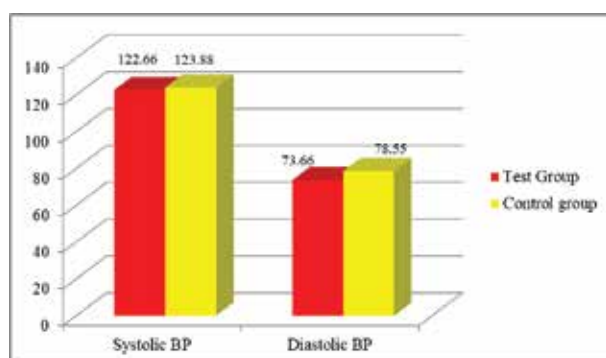


Fig. 1: Graphical presentation of Effect of tamarind on blood pressure (in mm of Hg).

DISCUSSION

Patients who are suffering from primary stage II hypertension shows persistent rise of blood pressure in which systolic blood pressure ranges from >160 & diastolic blood pressure ranges from >100 with idiopathic cause.¹⁵ Treating hypertension has become more challenging due to presence of coexisting morbidity. Use of polypharmacy is a common phenomenon to treat moderate to severe hypertension. The burden of drug can be

lessened by concomitant use of natural herbs that are easily available around us. *Tamarindus indica* which is locally known as tamarind is a herb that contains certain health benefiting essential volatile chemical compounds, minerals, vitamins and dietary fiber.^{16,17} Every part of Tamarind plant not only has nutritional value but also has broad usage in the area of medicine.¹⁷ Tamarind is a wonderful anti-inflammatory, anti-cholesterol, anti-bacterial and antioxidant agent.¹⁸ Due to its natural anti-inflammatory properties, tamarind is very effective in treating inflammations, in the heart arteries or walls, caused by heart disease. Tamarind also has carb-fighting properties that make it a very good food to prevent cardiovascular diseases. Its anti-cholesterol properties help destroy plaque that may accumulate in the arteries surrounding the heart. The high potassium content of tamarind helps in regulation of heart beat and maintains blood pressure.¹¹ The data generated in the study which was undertaken among 90 participants suffering from stage II hypertension. Among these 90 participants, 45 participants were taken as control group was only on drug and the other 45 participants were taken as intervention group. Pulverized pulp of *T.indica* fruit was given orally at a dose of 15mg/kg body weight daily to each experimental volunteer of intervention group for 8 weeks. The age of the participants ranged between 25 to 60 years with mean age 52± 8 years. The mean age indicates that incidence of hypertension increases with age.¹⁹ Oscar A et al²⁰ suggested in industrialized countries systolic BP rises throughout the life, where as diastolic BP rises until age 55 to 60 years. The percentage of male and female of the present study was 52.22% and 47.77% respectively. Hypertension is more prevalent in men though menopause tends to abolish this difference.²⁰ The rates vary markedly in different regions with rates as low as 3.4% (men) and 6.8% (women) in rural India and as high as 68.9% (men) and 72.5% (women) in Poland.²¹

Prevalence of educated people is higher in the study because health seeking behavior is more common in educated people.

In present study, most of the patient was symptom less (41.11%). Marshall et al²² indicated that hypertension rarely accompanied by any symptom. The other participants who had symptoms, the commonest presenting symptom found in this study was dizziness (23.33%). Out of 90 patients, 23.33% patients complained of dizziness. Other important symptoms were headache (18.88%), tiredness (13.33%). Di Tullio et al²³ shows that prevalence of dizziness is more among hypertensive than headache. The prevalence of risk factor of hypertension showed that out of 90 participants 27.7% were obese and 20% were sedentary worker. Agrawal et al²⁴ suggested that prevalence of obesity and sedentary worker among hypertensive patient was 18% and 18.5% respectively. Most hypertensive adolescents are obese and have a family history of hypertension and obesity.²⁵ Obesity, which increases plasma volume and cardiac output, not only causes high blood pressure, but increases the risk of cardiovascular disease in adults.^{25,26} Lack of physical activity may increase the risk of developing hypertension by 20-50%.²⁶ In present study, shows smoker was 33.33% and 7.7% participants had positive family history of hypertension. Agrawal et al²⁴ suggested that prevalence of smoker and positive family history among hypertensive patient was 16% and 7.4% respectively. The prevalence of alcohol and salt intake was 5.5% and 35.55% respectively. Agrawal et al²⁴ observed the prevalence of alcohol and salt intake among hypertensive patient was 9.4% and 34.2%. Substance use, including excessive alcohol intake, tobacco use, and drugs or medications with pressure effects such as steroids, oral contraceptives, cocaine, and diet pills or herbs containing stimulants, can significantly raise blood pressure levels.²⁷

The data generated in this study indicates that fruits of *T.indica* has diversified effect on blood pressure in stage II hypertensive patients. Pulverized pulp of *T.indica* was found to lower the diastolic blood pressure significantly ($p < 0.05$) though it had no effect on systolic blood pressure ($P > 0.05$). It has been reported that long term consumption of food containing high potassium and low sodium content like tamarind helps to improve cardiovascular health. Tamarind is a rich source of potassium (628mg per 100g) as well as low sodium content (28mg per 100gm).¹² The high potassium content of tamarind helps to reverse the negative effect of sodium in blood and normalize blood pressure.¹⁹ High potassium intake is associated with lower BP. Potassium is a chemical which helps to lower blood pressure by balancing out the negative effects of salt.²⁸ Tamarind seed and fruit are also suggested as a nutritional support in patients with high blood cholesterol levels.^{13,29} Moreover the high potassium and low sodium content of tamarind helps to lower blood pressure and ensure cardiovascular health.¹³ The finding of this study reveals a new dimension on the effect of fruits of *T.indica* on hypertension, but further study is required in larger population to quantify and qualify the issue. In our country where polypharmacy is a common phenomenon to treat moderate to severe hypertension, use of natural herbs like *Tamarindus indica* may play important role in controlling blood pressure more effectively.

CONCLUSION

Tamarindus indica reduced diastolic blood pressure in stage II hypertensive patients. In Bangladesh where hypertension shows a rising trend, the finding of the study reveals a new dimension on the effect of fruits of *T.indica* on hypertension.

REFERENCES

1. Chowdhury, S., & Chowdhury, P. Prevalence of Hypertension among the Bangladeshi Adult

- Population: A meta-analysis of Studies between 2004 and 2014. *Cardiovascular Journal*, 2015; 7(2): 104-107. <https://doi.org/10.3329/cardio.v7i2.22251>
2. Sofowara A E. Medical plants and traditional medicine in Africa. Spectrum Books Ltd, Ibadan. 1993; 2: 288.
 3. A.K.M. Shahidullah. The Role of Medicinal Plants in Livelihood Improvement And Ecological Sustainability In Bangladesh. 2007: 7-42
 4. Nasrin Jahan Shammi. Effects of Tamarindus Indica on paracetamol induced hepatotoxicity in rats. 2011: 3-6.
 5. Ghani A. Medicinal plants of Bangladesh. 2nded: Asiatic society of Bangladesh, Dhaka. 2003: 1-65.
 6. Gupta A K, Misra N. Hepatoprotective activity of aqueous ethanolic extract of Chamomile capitula in paracetamol intoxicated Albino rats. *American journal of Pharmacology and toxicology*. 2006; 1(1): 17-20.
 7. Mirjalili MH, Moyono E, Bonfill M, Cusido RM, Palazon J. Steroidal lactones from Withaniasomnifera, an ancient plant for novel medicine. *Molecules* 2009; 14: 2373-2393
 8. Bhadoriya SS, Ganeshpurkar A, Narwaria J, Rai G, Jain AP. Tamarindus indica: extent of explored potential. *Pharmacogn Rev*. 2011; 5(9): 73-81.
 9. De Caluw E, Halamov K, Van Damme P. Tamarindus indica L. a review of traditional uses, phytochemistry and pharmacology. *Afrika Focus*. 2010; 23(1): 53-83.
 10. Glew RS, Erjagt DJ, Chuang LTS, Huang Y, Millson M, Glew RH. Nutrient content of four edible wild plants from West Africa. *Plant Foods Hum Nutr*. 2005; 60(4): 187-193.
 11. Bhadoriya SS, Mishra V, Raut S, Ganeshpurkar A, Jain SK. Anti-inflammatory and antinociceptive activities of a hydroethanolic extract of Tamarindus indica leaves. *Sci Pharm* 2012; 80(3): 685-700.
 12. Havinga RM, Hartl A, Putscher J, Prehsler S, Buchmann C, Vogl CR. Tamarindus indica L. (Fabaceae): patterns of use in traditional African medicine. *J Ethnopharmacol* 2010; 127(3): 573-588.
 13. Blaustein, MP (1977). "Sodium ions, calcium ions, blood pressure regulation, and hypertension: a reassessment and a hypothesis". *The American journal of physiology*. 232 (5): C165–73. PMID 324293.
 14. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Publication No. 04-5230; National High Blood Pressure Education Program, National Heart, Lung, and Blood Institute, National Institutes of Health. 2004. <http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.htm>.
 15. National High Blood Pressure (BP) Education Program Working Group on High Blood Pressure in Children and Adolescents (August 2004). "The fourth report on the diagnosis, evaluation & treatment of high BP in children & adolescents". *Pediatrics* 114 (2 Suppl 4th Report): 555–76. doi:10.1542/peds.114.2.S2.555. PMID 15286277.
 16. Samina KK, Shaikh W, Shahajzadi S, et al. Chemical constructions of Tamarindus indica L. Medicinal plant in Sindh. *Pakistan Journal of Botany*. 2008; 40: 2553-2559
 17. Wong KC, Tan CP, Chow CH, Chee SG. Volatile constituents of the fruits of tamarind. *Journal of Essential oil Research*. 1998; 10: 219-221
 18. Havinga RM, Hartl A, Putscher J, et al. Tamarindus indica L. (Fabaceae): Pattern of use in African medicine. *Journal of Ethnopharmacology*. 2010; 127: 573-588
 19. Vasan, RS; Beiser, A; Seshadri, S; Larson, MG; Kannel, WB; D'Agostino, RB; Levy, D (2002-02-27). "Residual lifetime risk for developing hypertension in middle-aged women and men: The Framingham Heart Study". *JAMA: the Journal of the American Medical Association* 287 (8): 1003–10.
 20. Oscar A Carretero, Suzanne Oparil. *Essential Hypertension-clinical cardiology : new frontiers*. University of Alabamaschool of medicine. birmingham.ocarretl@hfhs.org.
 21. Falkner B ."Hypertension in children and adolescents: epidemiology and natural history". *Pediatr. Nephrol*. 2009; 25(7): 1219–24. doi:10.1007/s00467-009-1200-3. PMC 2874036. PMID 19421783.
 22. Marshall, IJ; Wolfe, CD; McKeivitt, C."Lay perspectives on hypertension and drug adherence: systematic review of qualitative research". *BMJ (Clinical research ed.)* 2012;

- 345: e3953. doi:10.1136/bmj. e3953. PMC 3392078. PMID 22777025.
23. Di Tullio M, Alli C, Avanzini F, Bettelli G, Colombo F, Devoto MA, Marchioli R, Mariotti G, Radice M, Taioli E, et al. Prevalence of symptoms generally attributed to hypertension or its treatment: study on blood pressure in elderly outpatients (SPAA). *J Hypertens Suppl.* 1988 Nov; 6(1): S87-90.
 24. VK Agrawal, R Bhalwar, Basannar. Prevalence and Determinants of Hypertension in a Rural. *MJAFI* 2008; 64 : 21-25.
 25. National Heart, Lung, and Blood Institute. Report of the Second Task Force on Blood Pressure Control in Children-- 1987. *Pediatrics* 1987; 79(1): 1-25.
 26. Carretero OA, Oparil S. Essential hypertension. Part I: definition and etiology. *Circulation* 2000; 101(3): 329-335.
 27. Falkner B, Sherif K, Michel S, Kushner H. Dietary nutrients and blood pressure in urban minority adolescents at risk for hypertension. *Arch Pediatr Adolesc Med* .2000; 154(9): 918-922.
 28. Lawrence J. Appe. Dietary Approaches to Lower Blood Pressure. *J Clin Hypertens (Greenwich)*. 2009; 11: 358–368
 29. A Siftekhar, I Rayhan, M A Quadir, S A Zaman, A Hasnat. Effect of Tamarindus Indica Fruits on Blood Pressure and Lipid-Profile in Human Model: An In Vivo Approach. *Pak. J. Pharm. Sci.*, 2006; 19(2): 125-129